Spatial Systems Associates, Inc. is a small business that specializes in Geographic Information System (GIS) and Facility Management Information System (FMIS) design, deployment and support services. Our FMIS product, **SpatialMMS**, provides the ability to:
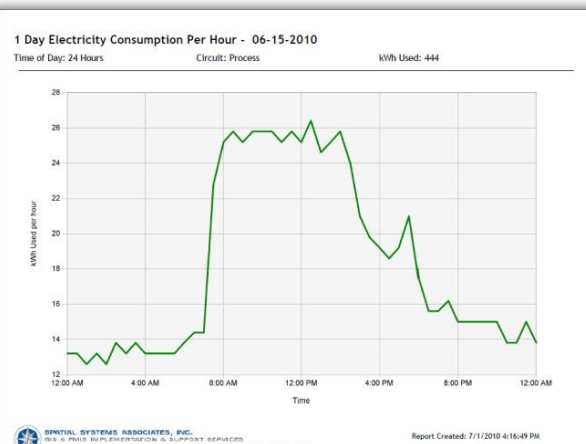
- Capture
- Store
- Analyze
- Report on

a variety of building indices, including energy use, water use, indoor environment (temperature, humidity, CO_2 levels) and site characteristics.

Powered by industry leading Esri ArcGIS Server mapping software, **SpatialMMS** functionality follows the guidelines established in the document **"Performance Measurement Protocols for Commercial Buildings" (PMPCB)**; a document jointly authored by the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE), the U.S. Green Building Council (USGBC), and the Chartered Institution of Building Services Engineers (CIBSE) and published in 2010.

SpatialMMS Electricity Consumption Graph

The **energy management functionality** of SpatialMMS can be configured to monitor an entire building's energy use, the energy use of individual building subsystems (i.e. HVAC, lighting, process power (receptacle loads), etc.), or down to the circuit or plug level. Energy consumption is metered continuously, with readings from the sensors taken at appropriate intervals. These readings are stored in an SQL-compliant database, and are **a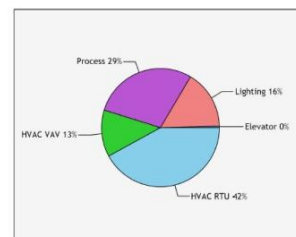vailable for analysis on-demand** through our online interface. The analysis can be performed on energy consumption readings over the last hour, day, week, month, or over a period of years. Standard reporting displays graphics that show energy consumption rates as a function of time.

On demand, operations or management personnel can generate **summary energy consumption information** in both tabular and pie chart format for user-defined date ranges to both understand the relative amounts of energy that are being consumed by individual subsystems, but also to check the utility bills from commercial power providers to insure that billing is correct.

For building lighting subsystems, **SpatialMMS** can show the location of individual fixtures, locations of switches
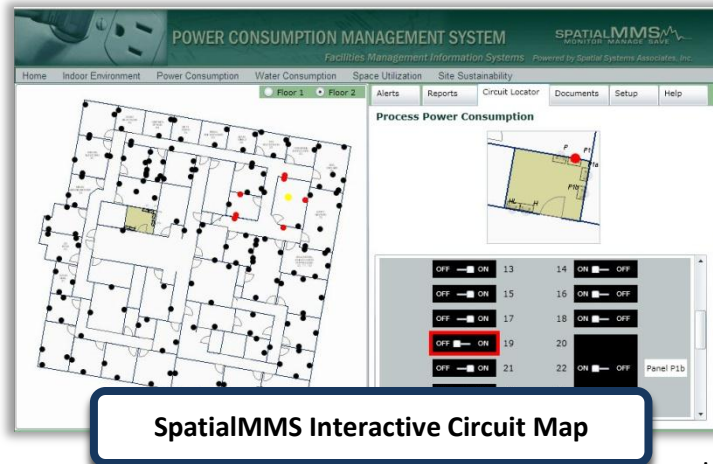

SpatialMMS Electricity Consumption Report

that control the fixtures and the electrical circuit on which that fixture resides, and can include detailed information about each fixture (manufacturer, model, type of bulb used, when last replaced, etc.), along with energy consumption data down to the circuit level if necessary.

**SpatialMMS Interactive Circuit Map**

For process power (duplex receptacles), **SpatialMMS** displays the locations of all receptacles, and the circuit breaker that controls the receptacle. Selection of an individual receptacle automatically displays the other receptacles that are on the same breaker. If necessary, **SpatialMMS** can monitor the energy consumption at each plug. This capability not only assists in monitoring energy use but also protects the building circuitry by alerting maintenance staff via automatically generated alerts in the form of emails or text messages when individual plugs or circuits are drawing more current than the wiring or plugged components are designed to carry. This additional level of overload protection can prevent overheating of wiring and potentially prevent a dangerous situation or a fire.

Consumption information that is continuously polled and stored online is instantaneously available to building operators and, if desired, to tenants for monitoring of the success of energy reduction goals.

Further, since energy can be monitored and reported at a very discrete level, calculation of energy use by tenant is facilitated for chargeback purposes.

SpatialMMS Power Use by System Display

All of this energy consumption information can be accessed by building operations or management personnel on-demand. Default calculations include total energy consumption segregated by building subsystem, displayed both in a pie chart and in chart form. Display of energy consumption by subsystem by time of day is also available as shown on the previous graphic. Calculations are also performed to estimate the total carbon emissions resulting from the energy use of the facility, and the EUI is calculated for comparison to similar buildings.

If desired, the **SpatialMMS** system can feed information into a standard building modeling package and interface to available online weather data to both predict and report energy consumption based on
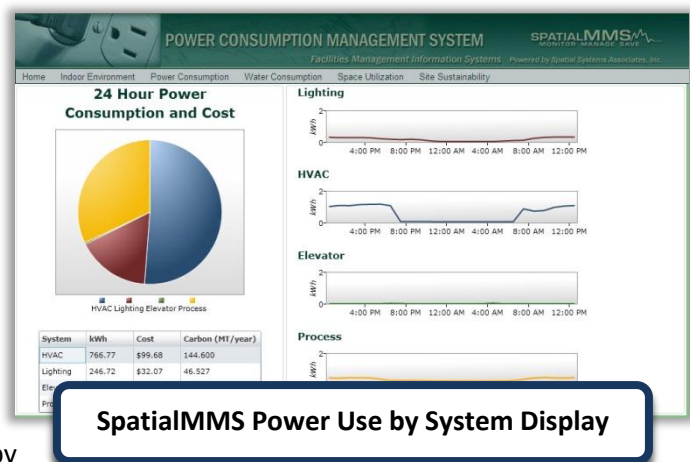
weather conditions to determine whether the overall building (HVAC systems and building envelope) are performing as expected regarding thermal conditions.

This level of monitoring detail is not limited to the power consumption characteristics of the facility, but can be extended to include potable water subsystems and consumption records, indoor environment characteristics (temperature, humidity, CO_2 levels, VOCs), lighting levels, site characteristics (locations of utilities, stormwater conveyance, parking, site lighting, terrain, aerial photography, etc.); hazardous materials (asbestos, lead, mercury, etc.), fire system components (sprinklers, piping, alarm locations, annunciators, fire walls/doors, fire stops, suppression systems and extinguishers); and space utilization (tenant space assignments, furniture and equipment inventory, space availability, etc.).

SpatialMMS is thus a complete web-based facility management tool, configurable to meet changing demands of the end user. **SpatialMMS** is extensible, allowing for incorporation of additional monitoring components or subsystems as the need arises. Individual monitoring components are COTS products, meaning that as new technologies

SpatialMMS Systems Dashboard

become available, they can be incorporated into SpatialMMS without significant cost or effort. Further, the system has been designed to capture, monitor and report information that is necessary to achieve and retain USGBC's LEED certification for commercial buildings, and thus can assist the building owner in not only monitoring and accounting for total energy use down to the smallest component but also in achieving sustainability goals that have been established by government oversight.

ASHRAE's PMPCB suggests **Basic, Intermediate** and **Advanced** protocols for measuring and reporting building characteristics for energy use and other building purposes. Spatial Systems' **SpatialMMS** product provides for whatever level of energy monitoring detail the customer desires deems necessary.

Basic energy monitoring is achieved at the building level, but does not provide for reporting or analysis of energy use either for building subsystems (HVAC, lighting, process power) or for individual tenants or portions of buildings. The **Basic** level does provide for checking of total energy use against billing consumption data from the local utility and for calculation of the Energy Use Index (EUI) for a building for comparison with similar buildings in the country.

The **Intermediate** energy protocol described within PMPCB suggests establishing a breakdown of the energy consumption within a building as a function of major end-use, i.e. HVAC, lighting and process power and provides for calculation of the electrical load factor (ELF) and the occupant load factor (OLF); but does not provide for detailed reporting and analysis by equipment component or by area within the

building. The intermediate level therefore also provides for evaluation and benchmarking of the whole building utilizing appropriate energy use modeling.

The **Advanced** level of energy use monitoring described within PMPCB describes establishing a system that will track energy performance on a daily or hourly basis for both the whole building and for sub-metered components. It envisions energy use monitoring by subsystem and by area within the building, thus allowing for the ability to separate energy use within a facility by:

- Subsystem – HVAC component (chiller, fan, VAV box, non-electric heating, etc.), lighting, process power, elevator, and other power consumption subsystems
- Location – the ability to monitor and report energy consumption as a function of the area within the building that is consuming the energy. This ability would allow for facilitation of charging building occupants for the energy they consume, thus encouraging energy conservation and insuring that the consumers of energy are paying their fair share of the total energy cost.
- Time of consumption – the ability to track and report energy consumption by day of week and hour of day at the subsystem and location level of detail. For locations that are billed as a function of peak demand within a billing period, this ability would allow management to identify the occupants who are causing higher peak demand rates, and to mitigate those rates by encouraging tenants to reduce consumption, provide supplemental resources to provide for peak shaving, or to charge those tenants responsible for the increased rates.

Advanced metering also provides the ability to monitor expected performance improvements resulting from retrofits or changes in operating characteristics.

The **SpatialMMS** system also provides for integration of as-built information regarding the facility (scanned images of hardcopy drawings, picture records taken during construction, equipment operating manual and maintenance schedules, etc.) that can be used by facility operations personnel in their daily work.

SpatialMMS Document Management

Spatial Systems' services include system design; component acquisition/installation; base data development; establishment of a customized web-based site for monitoring of consumption data, analysis, and generation of reports; on-call support and training. We can also provide ongoing monitoring of the system if desired.

Spatial Systems Associates (www.spatialsys.com or 410.423.1870) would be pleased to demonstrate **SpatialMMS** and show how it can be used to manage/minimize your energy use and costs.